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APPLICATIONS WORKSHOP III-B-1

MATERIAL AND METALLURGY

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Workshop Consultant: Sherry Holmes (SL)

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Mario Di Giovanni, Statham Instruments was particularly interested in transducers and suspension-type instruments exposed to saline solutions of the human body. Havar Elgiloy, or titanium alloys would be the best material for rolamite bands in this kind of environment.

CORROSION OF MATERIALS

In a discussion of fretting corrosion in rolamite mechanisms, Don Wilkes pointed out, "Any highly stressed material, such as a rolamite band in the area of the bend where it is in contact with the rollers, is vulnerable to stress corrosion. If the environment is corrosive, the design should include a sealed chamber. It would be appropriate also to consider a very thin coating of plastics to seal the band from the environment. Since plastics typically have a modulus of about one fiftieth to one one-hundredth of steel, the effect of the thin plastic on the stiffness of the band would be negligible. It is also appropriate to consider using dry lubricant films to minimize the possibility of fretting corrosion and cold welding."

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BAND LUBRICATION

In reply to Mr. Martin's suggestion that a lubricant would decrease the torque required to cause slippage between the band and roller, Wilkes agreed. However, in most of his applications slippage was not a problem, since they were low motion devices with the band pinned to the roller.

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PROPER BAND ATTACHMENT

In experimenting with Havar, Statham had been having problems with breakage at the point of attachment. Mr. Walmer suggested that when attachment involves a pin through a hole in the band, very high stress levels can be encountered at the point of contact of the band with the pin. One method of band attachment involves the use of a threaded pin. After the band is in place, a thin plastic washer is slipped down over the pin and the band is clamped using a nut similar to those used on a No. 6 dry cell. This method eliminates point contact of the band against the pin and prevents the high localized stress which causes bands to tear out at the hole.

Mr. Walmer gave the calculation for the minimum bend radius for a rolamite band using the formula

$$t_{max} = \frac{\sigma_y d}{E - \sigma_y}.$$

Since the yield stress is small compared to the modulus, the formula becomes

$$t_{max} = \frac{\sigma_y d}{E}.$$

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Ernesto Martin, Communications Satellite Corporation, who expressed a need for low rpm rolamite bearings for infinite lifetime without lubrication, asked about present production of endless bands.

ENDLESS BAND PRODUCTION ROLLING

Dr. Polokowski at the Illinois Institute of Technology, Chicago, is working on a process to make endless bands for any application which would require them. A sample of one of the first bands that he made was on display. Professor Polokowski's method consists of starting with a piece of tubing which is slipped over one roll of a rolling mill. As the rolling proceeds, the band lengthens and gets thinner. There is no weld joint if the starting material is seamless tubing. If welded tubing is used, the repeated cold-working and annealing during the process erases the weld.

These bands are not yet a production item, but endless bands to thicknesses of 0.002 inch look feasible. Problems which have to be solved are crown across the strip, and waviness.

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ELECTRODEPOSIT

Sherry Holmes added that endless belts can be made by electrodepositing nickel or high nickel alloys on an aluminum cylinder. Then, after etching away the aluminum, a flat, endless band remains. This would be suitable for making endless bands where high strength is not a requirement. Sandia had also, using this process, made a bellows which exhibited no mechanical hysteresis.

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FAILURE MODES OF BANDS IN SPACE APPLICATIONS

In reply to a question by Martin, RTI's Don Wilkes agreed that cold welding would occur to a certain degree in rolamite applications in outer space.

When the roller moves off the point of weld, said Wilkes, "you might have a detent effect produced to some extent but it would be slight, since the weld projection would open a small depression on the opposite side. A reasonably tight geometry allows essentially no slippage between band and rollers; the projection and depression always match up, causing little, if any, detenting action."

Because of the small size of cold-weld points compared to the functional cross-section area of the band, broken cold-weld points do not measurably weaken the band. Wilkes pointed out that some materials are more likely to weld than others; beryllium copper would be one that is not likely to cold-weld.